In Salah Gas

Carbon Dioxide Storage In The In Salah Gas Project Central Algeria

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Abstract

Carbon Dioxide Storage in the In Salah Gas Project. Algerian Central Sahara

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The In Salah Gas Project is a BP/Sonatrach Joint Venture that is targeted to produce 9 bcm/y from several gas discoveries located in the Ahnet - Timmimoun Basin, in Central Algeria. These fields, located 500 kilometres from existing gas export infrastructure at Hassi R'Mel, requires a multi billion dollar investment in new pipelines and gas processing infrastructure, with the exported gas destined for the markets of Southern Europe.

Gas production from the In Salah gas fields, contain significant fractions of carbon dioxide ranging from 1%-9%. To meet gas composition specifications for the gas transmission network it is necessary to remove a large proportion of this carbon dioxide in the processing facilities, prior to export. Sonatrach and BP both have goals to reduce greenhouse gas emissions to the atmosphere, so disposal of the carbon dioxide into the atmosphere was not an option. A review of alternative uses for the carbon dioxide was therefore undertaken, leading to selection of sub-surface storage in Tournaisian aged reservoir sandstones adjacent to one of the main gas fields, as the preferred option.

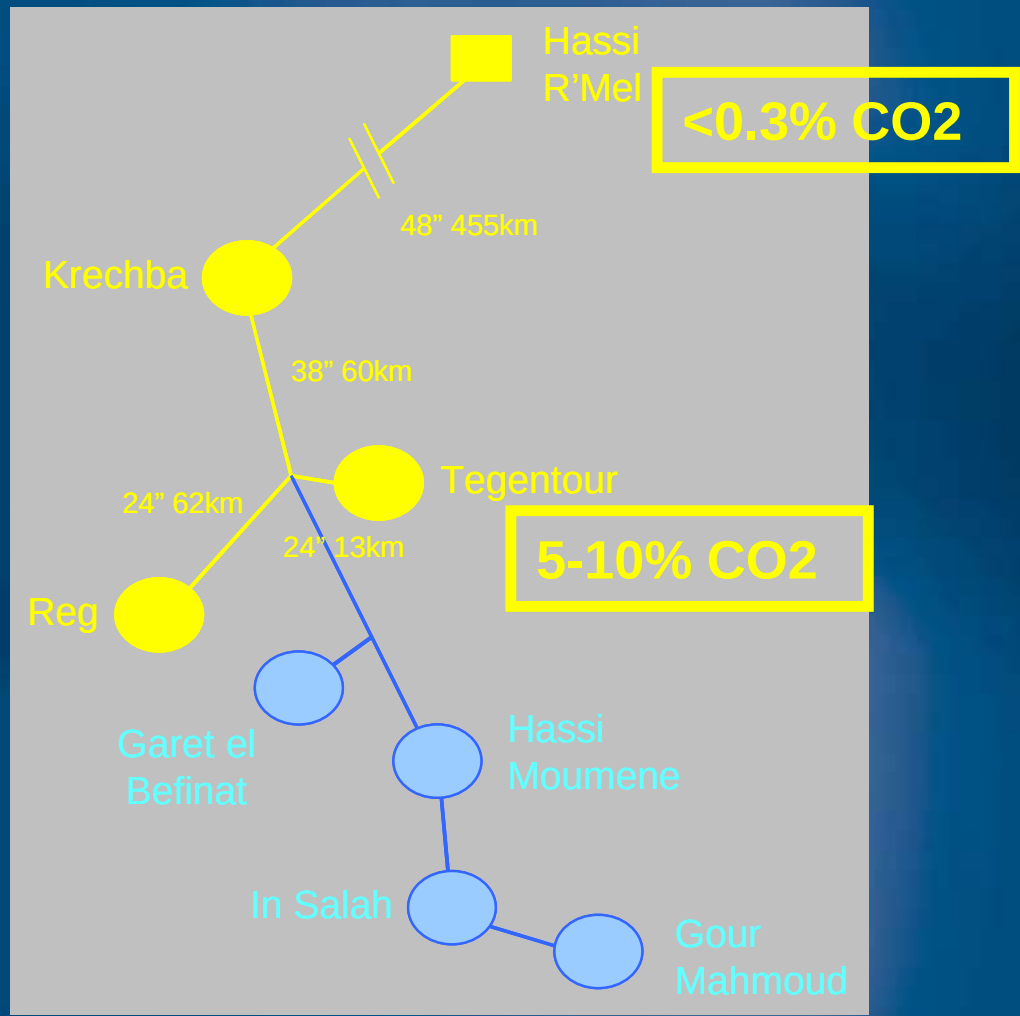
Detailed reservoir simulation modelling was used to aid the design of the carbon dioxide storage scheme, as was 3D seismic, which helped define the reservoir storage potential, reservoir quality and target well locations. Full equation of state simulation was used to capture the sub-surface phase behaviour of the injected carbon dioxide. Model results were used to identify injection well locations that satisfy a number of criteria the most important being to avoid carbon dioxide breakthrough or leakage to the gas producing wells during the life of the field, access to sufficient connected pore-volume to accommodate the predicted volumes of carbon dioxide, which over the life of the project runs to ~0.5 Tcf of CO_2(~25 million Tonnes) and storage integrity with the free CO_2 migrating back into the hydrocarbon trap over time once production had cessed.

The first of the CO2 injection wells has been drilled with the remaining 2 wells to be completed for first gas, in 1Q04. The impact of this scheme is to reduce emissions from the In Salah Gas project by ~60%.

Talk Outline

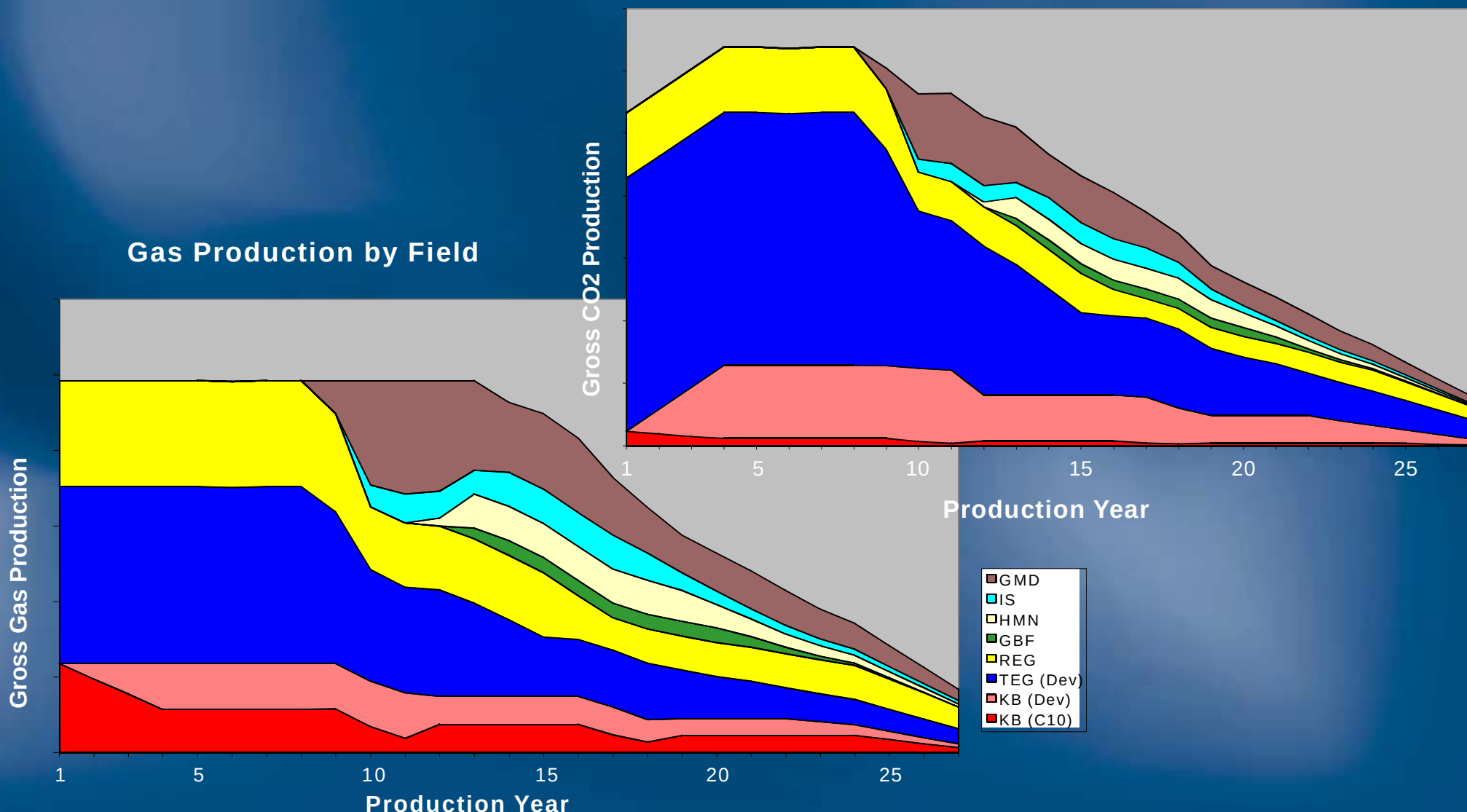
- **Outline of In Salah Gas Project – Scene Setting**
  - Sonatrach/BP Joint Venture
  - Multi-field Gas Development
- **Options for Managing CO_2**
  - Storage of Associated Produced CO_2
  - Management of Facilities Generated CO_2
- **Minimising Risk**
  - Assurance of Storage Option
  - Prediction of CO_2 behaviour
- **Project Status**

In Salah Gas Project Location, Algeria

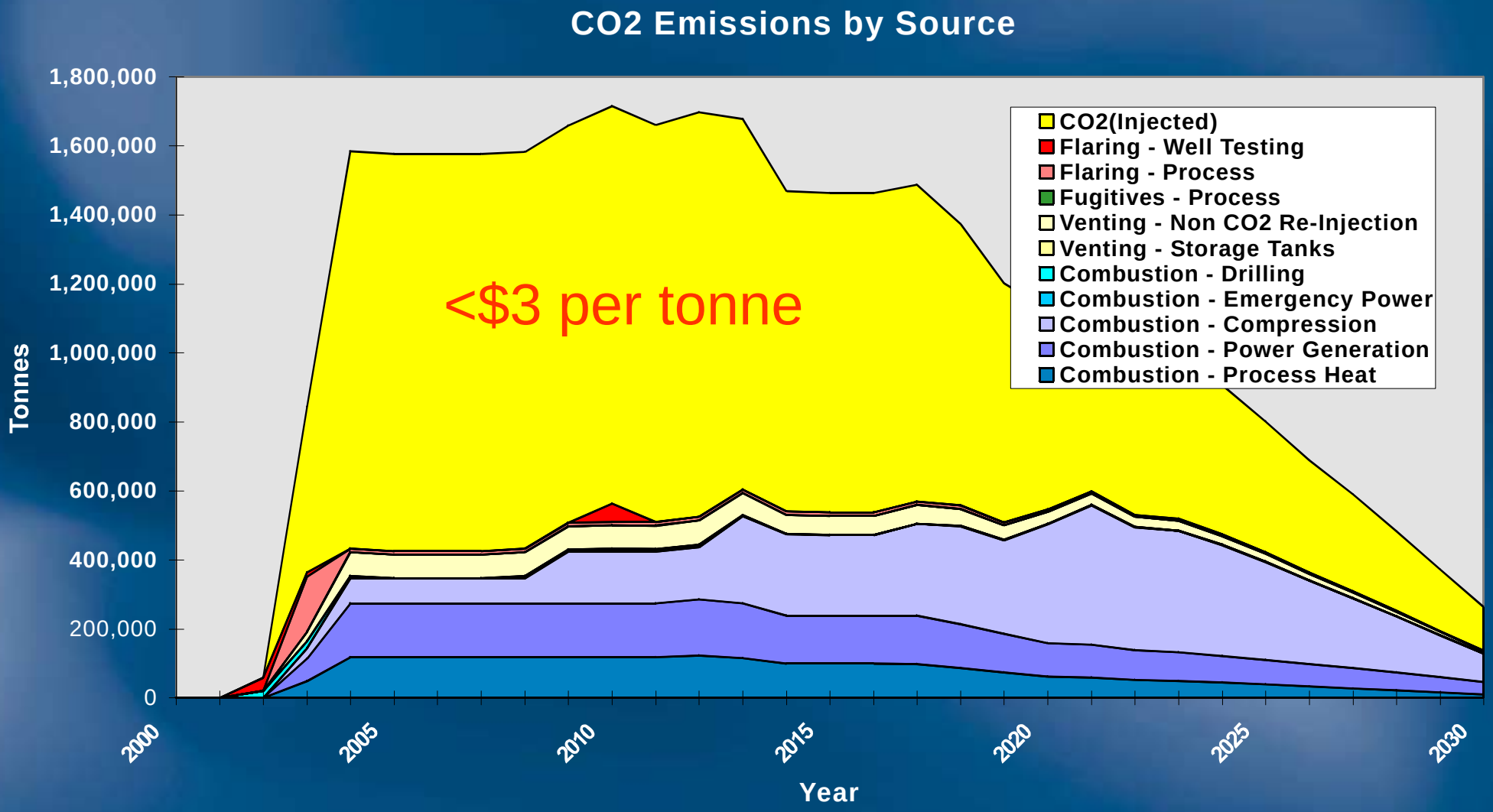


Carbon Dioxide Production Profile

- Maximum CO2 Production Rate ~60 mmscf/d
- Total CO2 Production ~450 bcf



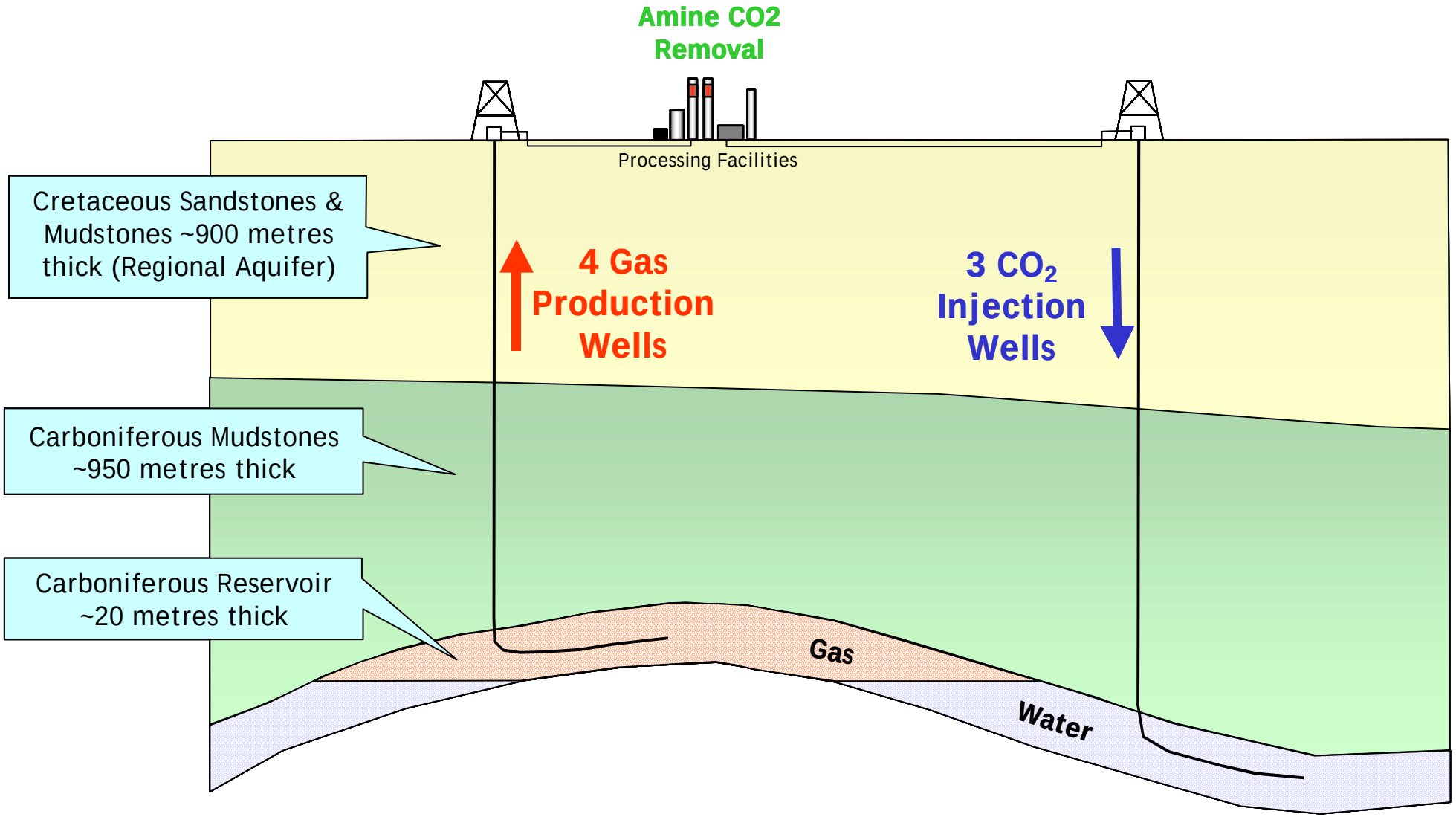
Evaluation of Emissions by Source



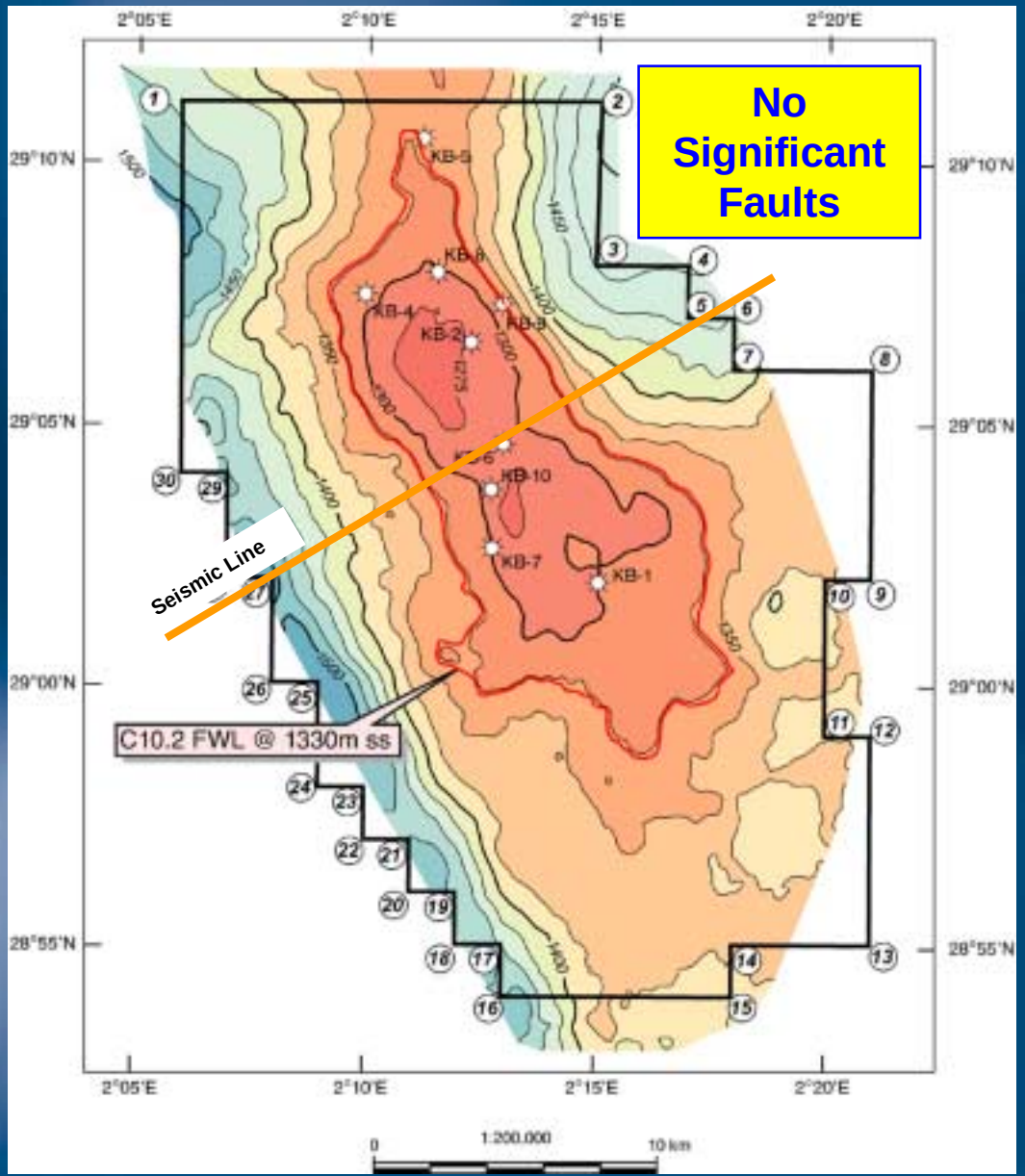
Review of Storage Options for Produced CO_2

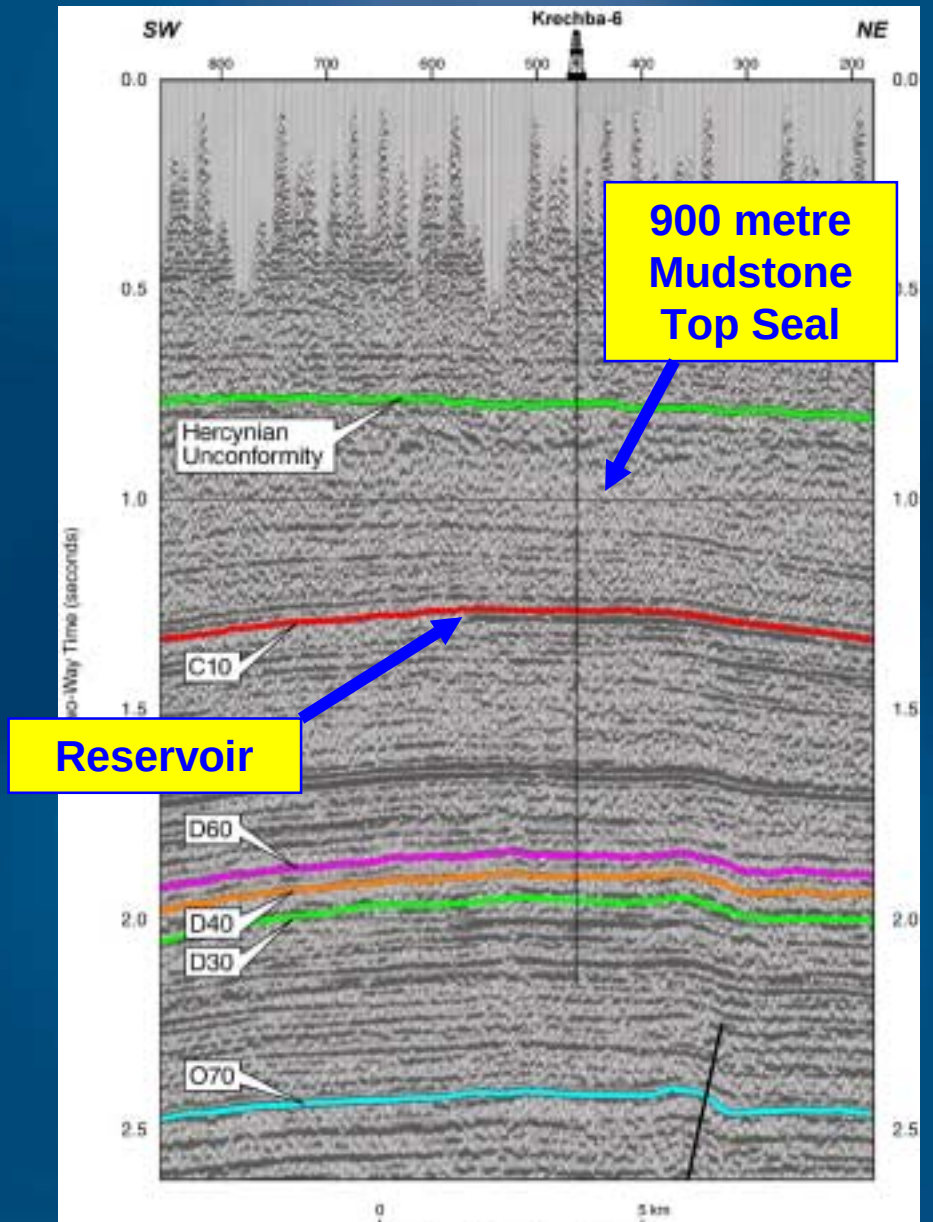
- **Robust storage site**
  - > Seal integrity
  - > Storage volume
  - > Reservoir quality
  - > Pressure below 6000psi
- **Single or multiple sites?**
- **Carboniferous reservoir at Krechba**
  - > Proven hydrocarbon trap
  - > 3D seismic data
  - > Appraisal wells

CO_2 Storage at Krechba



Krechba Geology





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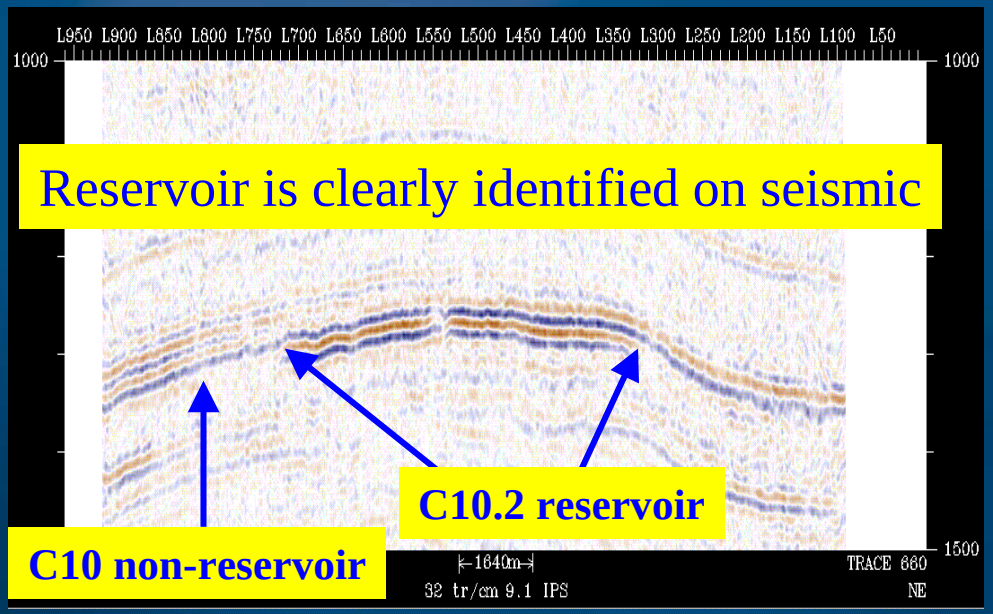
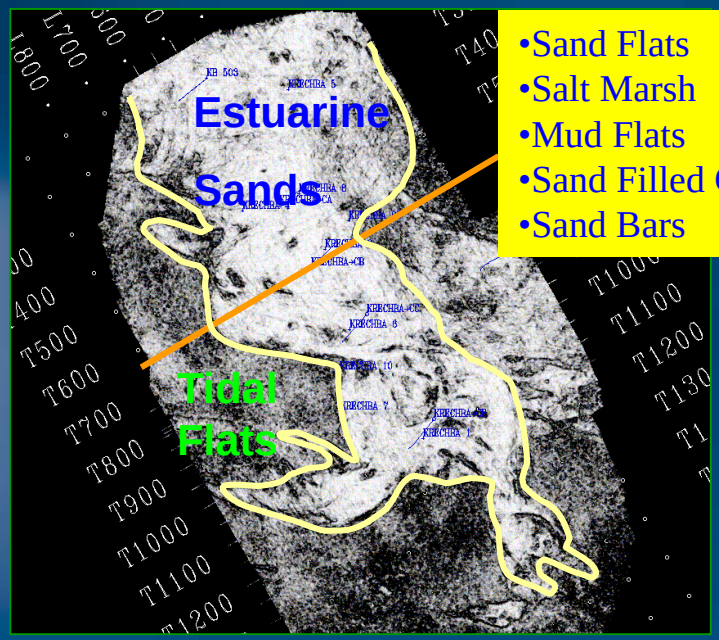
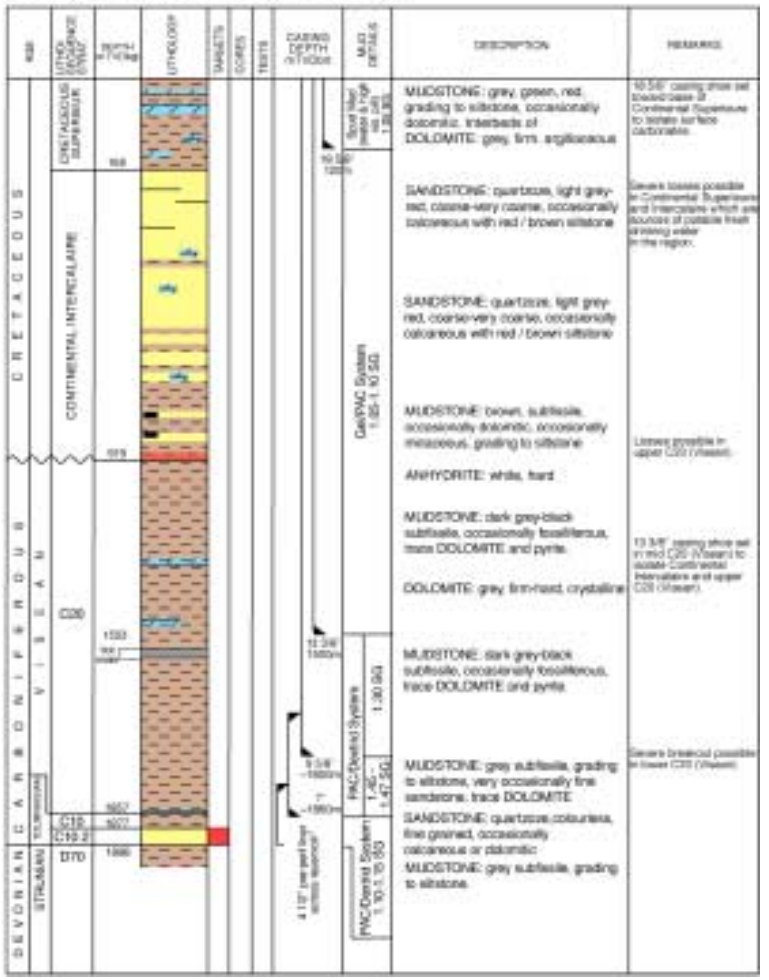




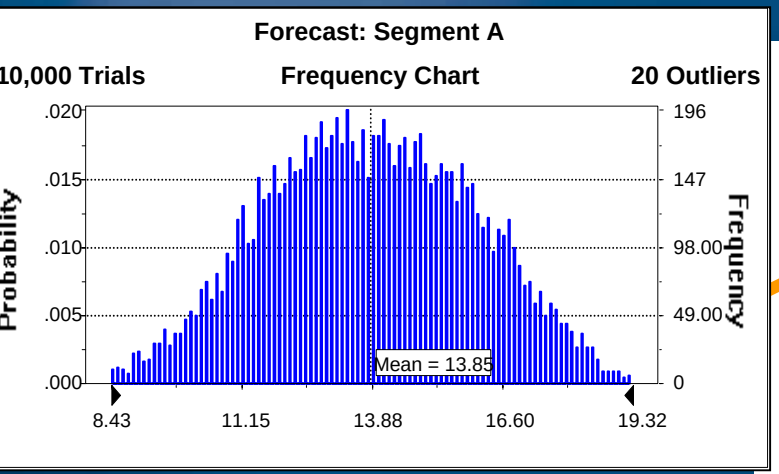
- Sand Flats
- Salt Marsh
- Mud Flats
- Sand Filled Channels
- Sand Bars

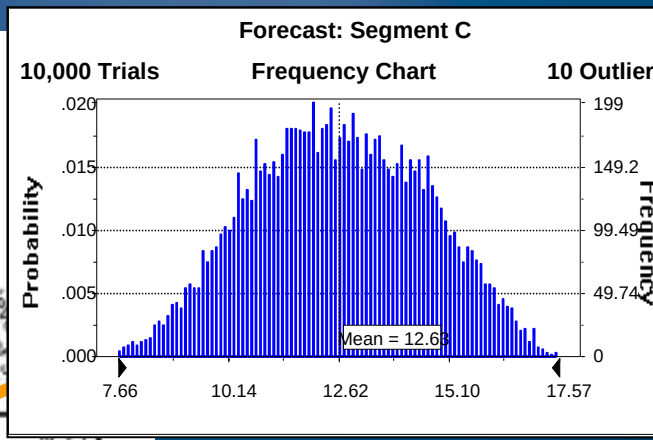
Krechba Geological Prognosis

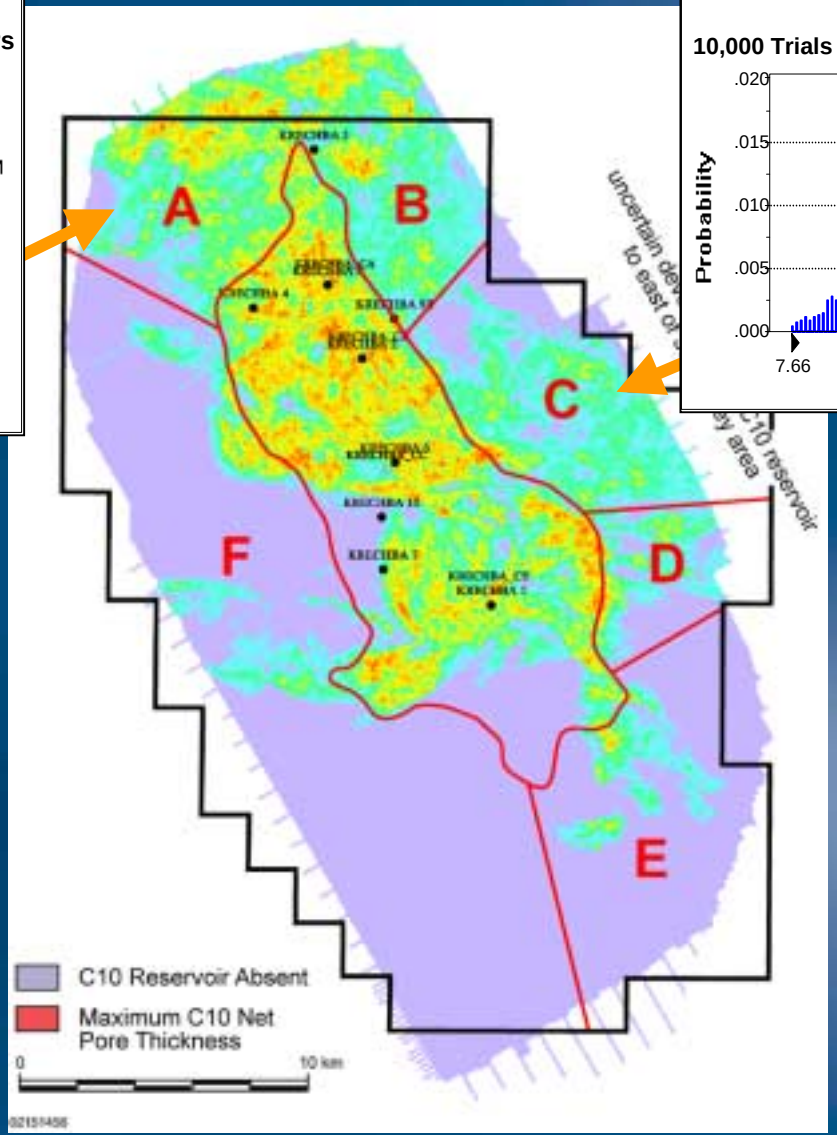
Ground Level Elevation ~470 metres above mean sea level

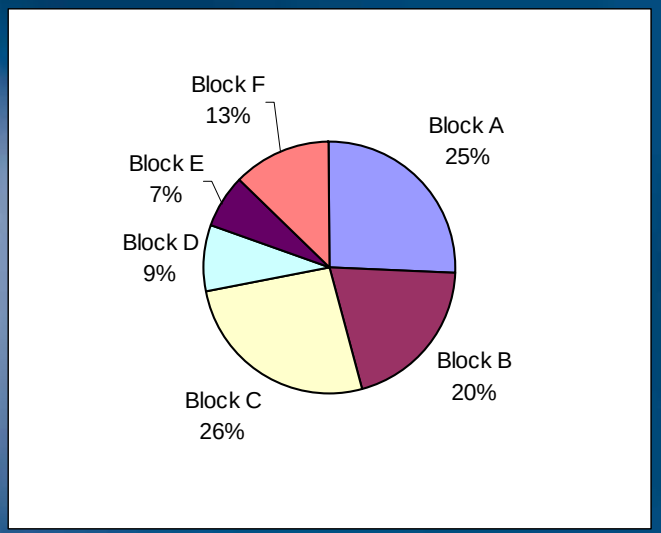


Forecast CO_2 Storage Capacity and Times (Years)

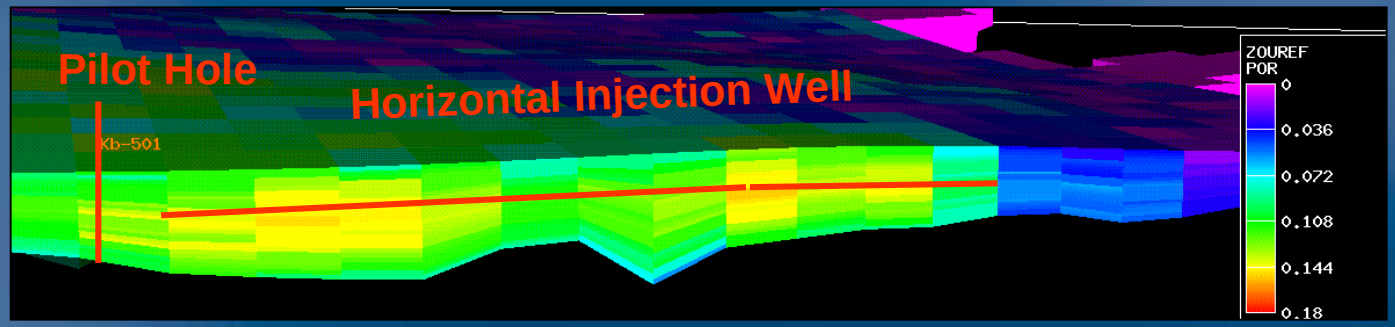


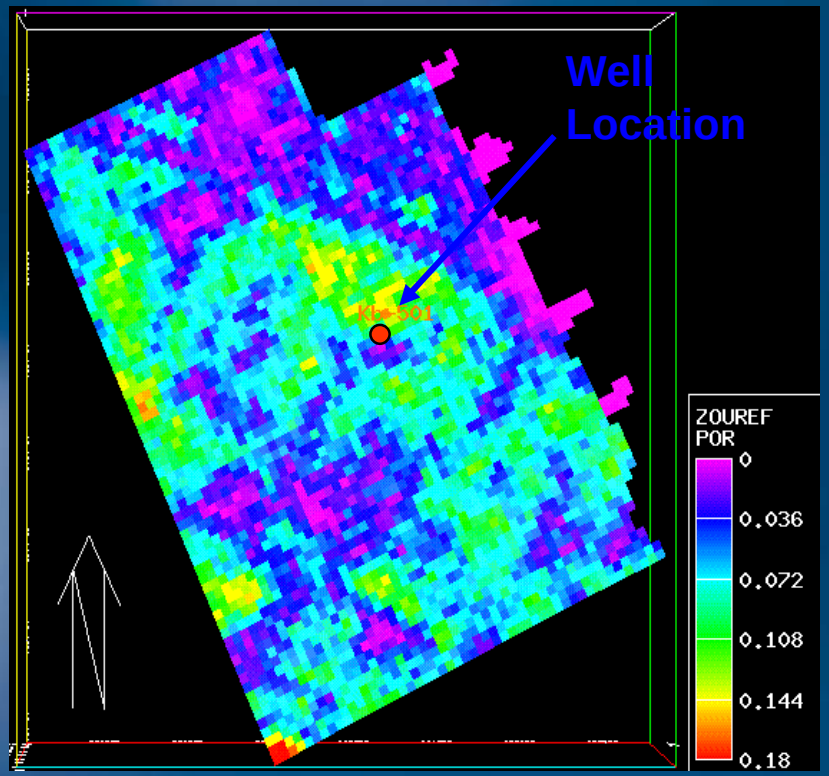


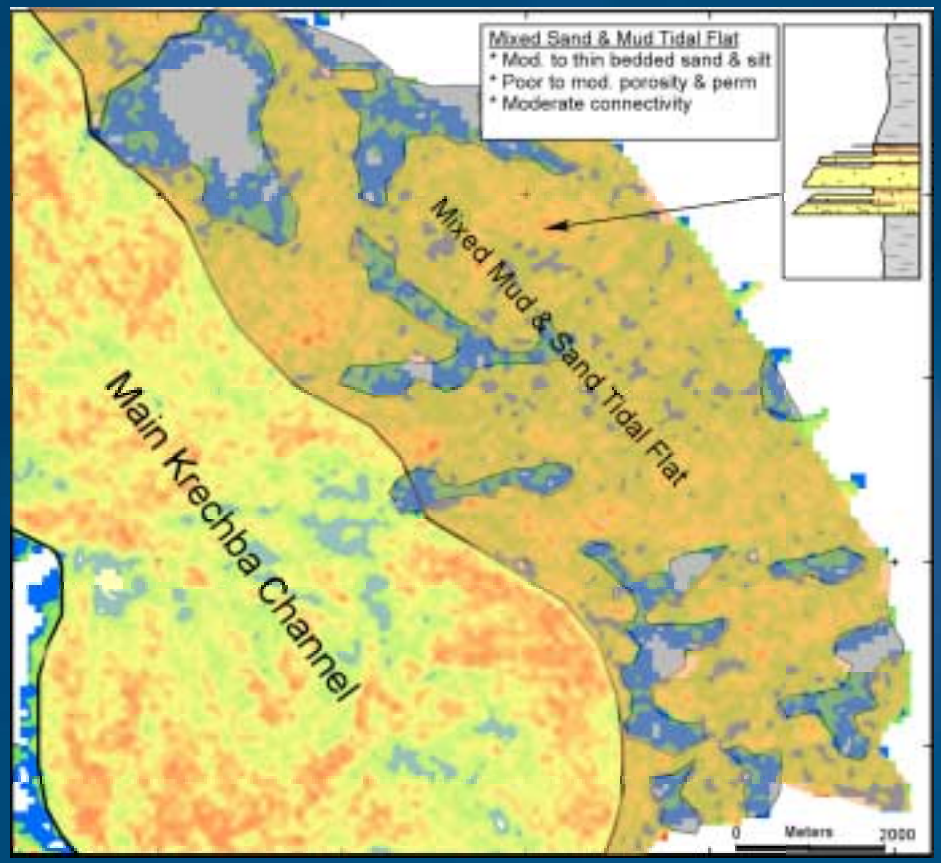




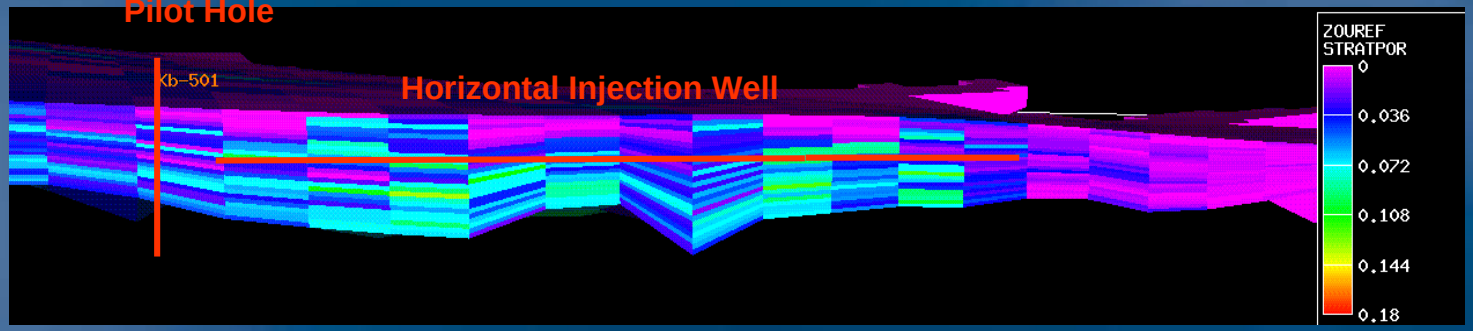
Simulation Models

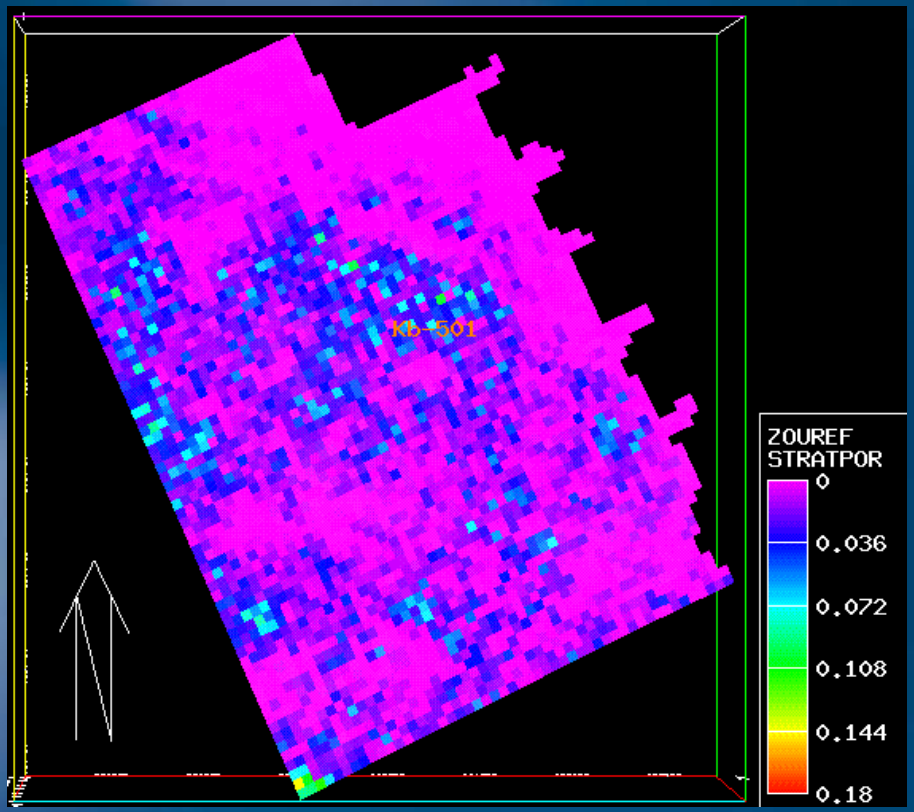


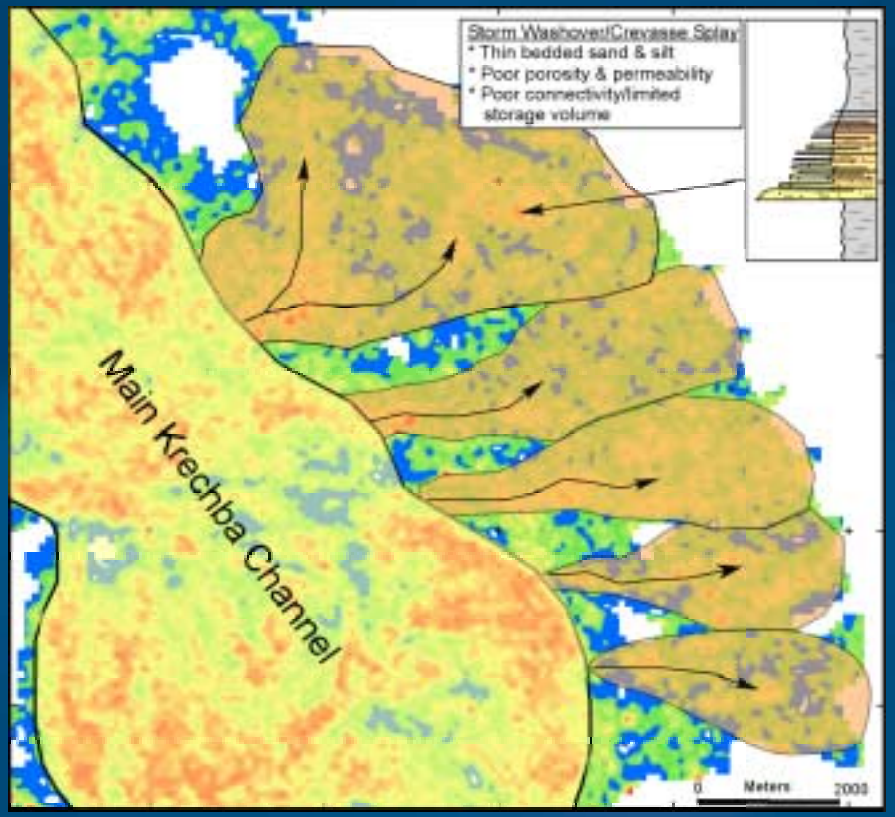




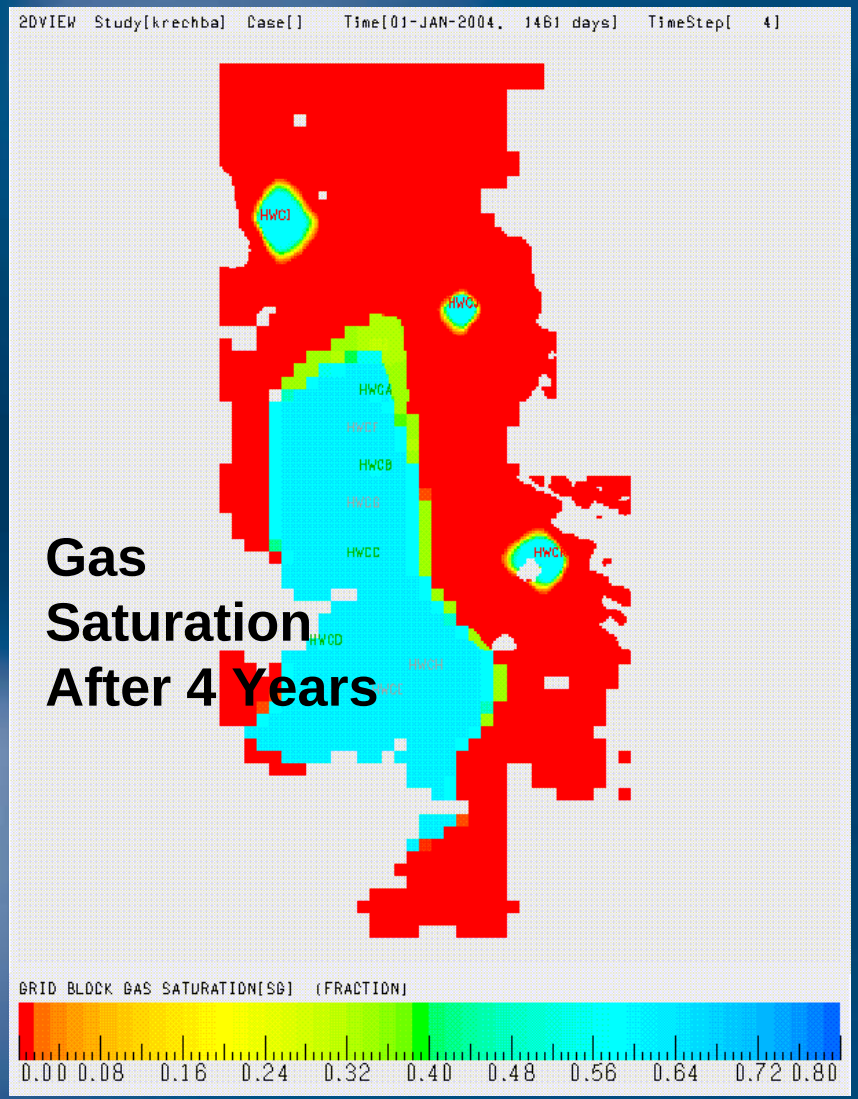
Alternative Models

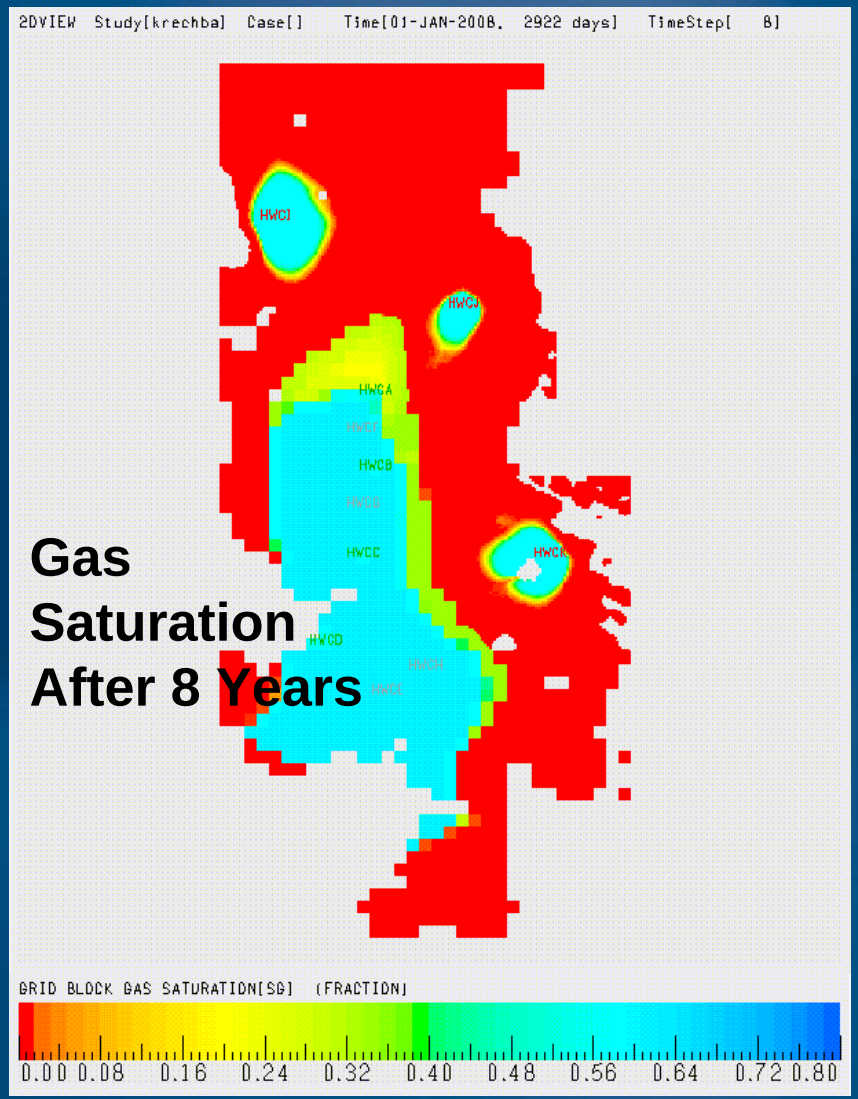






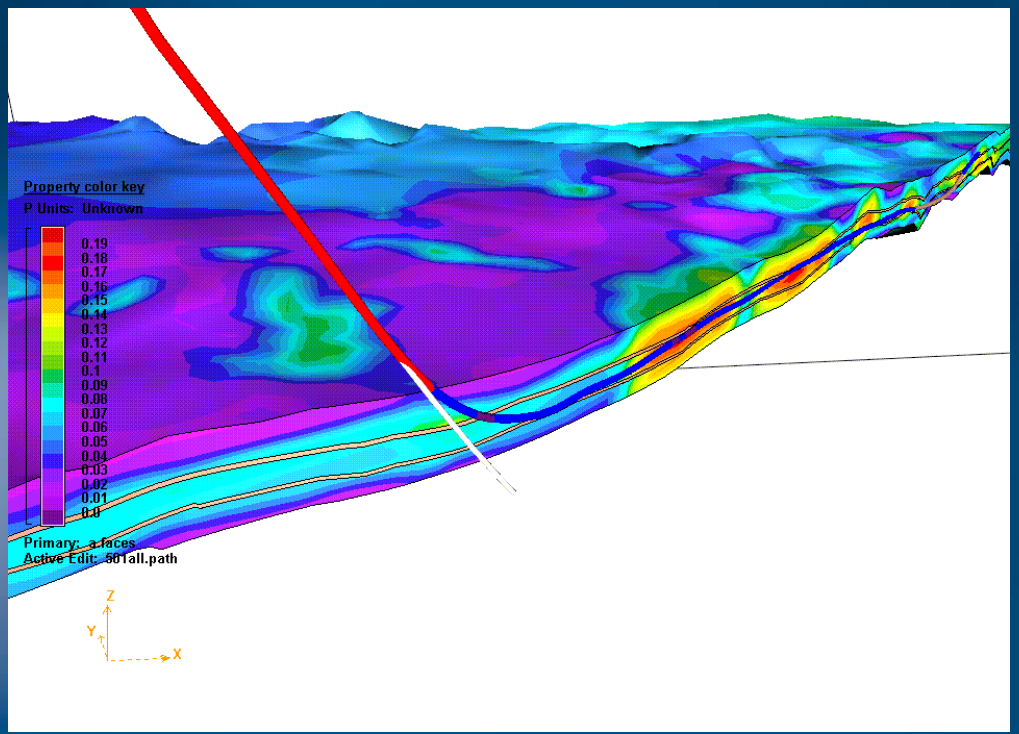
Simulated Impact of CO_2 Injection

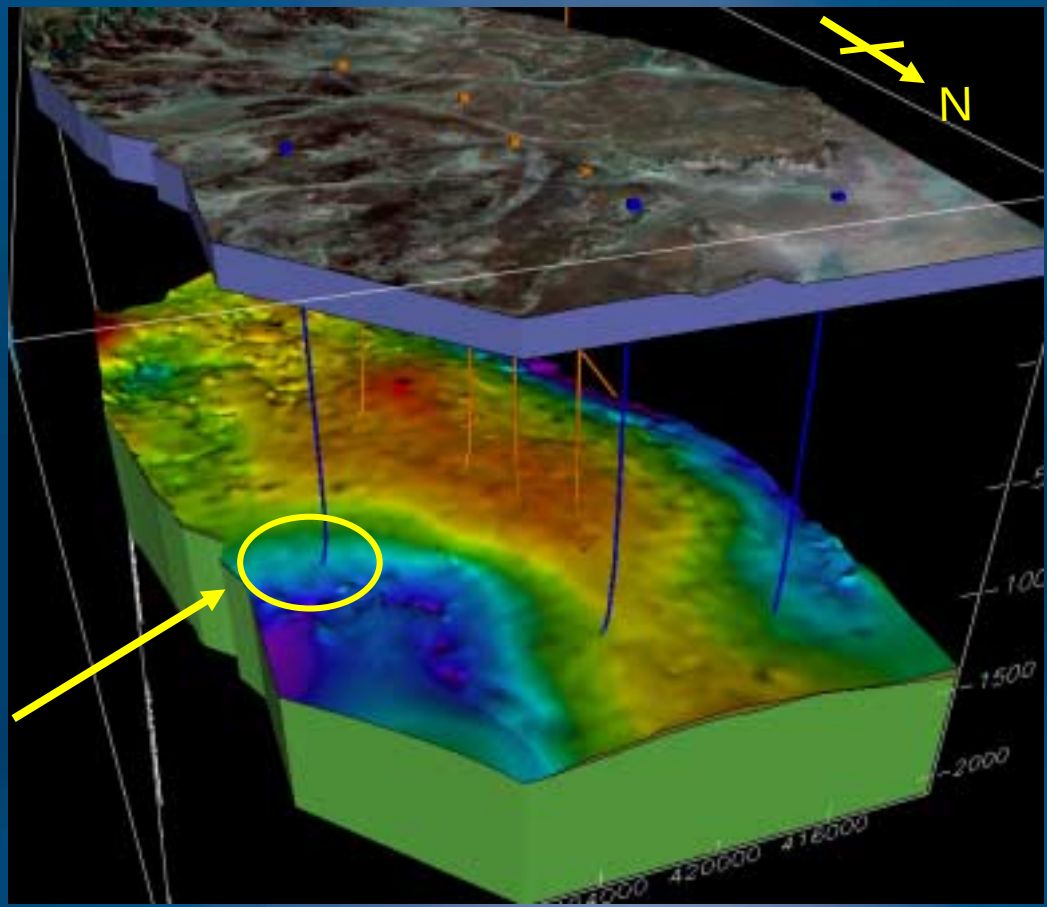




Drilling of the First CO_2 Injection

1250 metres of horizontal section in Krechba 501 completed in January 2003





2004 Project Start-Up

Conclusions

- The commitment of the BP/Sonatrach Shareholders was instrumental in achieving a shift into a new domain for environmental management.
- Management of total project emissions required identification of the source and their magnitude early in the design stage.
- Cost effective solutions and options for the future can then be integrated into the final design in an ordered and well understood manner.
- Re-injection of the Produced stream CO_2 has netted an emissions saving of ~0.9 million tonnes per annum (~$2.6/tonne)
- Clear HSE aspirations have resulted in the ISG project capturing savings in excess of 1.2 million tonnes per annum of equivalent green house gas emissions (>60% of total project emissions)

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